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Notes on the *demanii* Section Of Genus *Gonodactylus* Berthold With Descriptions of Three New Species (Crustacea: Stomatopoda)

By Raymond B. Manning
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Among the Indo-West Pacific species assigned to the genus *Gonodactylus* by Kemp (1913) was *G. demanii* Henderson, with two varietal forms, *G. d. spinosus* Bigelow and *G. d. espinosus* Borradaile. These three forms, characterized chiefly by their small size and small ocular scales, and, in the first two, by the strongly arched median carina of the telson and the presence of dorsal spinules on the telson, occupy an isolated position in the genus. Some authors, prior to Kemp's work, considered these forms to be varieties of *G. chiragra* (Fabricius, 1781); subsequent to 1913 they have been considered as distinct species or as three subspecies of *G. demanii*.

As noted above, very small size, with total length not exceeding 50 mm (in some species 30 mm or less), is characteristic of *G. demanii* and its allies. Kemp was certainly aware of this but apparently disregarded it in his attempt to order the apparent variants of the common *G. chiragra*. Earlier workers, notably Lanchester (1903), had recognized numerous lettered or named varieties of *G. chiragra*.

Lanchester attempted to arrange these in transitional sequences leading to a typical form; several of his transitional forms were based on small specimens (*G. c.* var. *incipiens*, *G. c.* var. *segregatus*) with obviously adult features of telson morphology. Kemp noted that small specimens varied more than adults and proposed (1913, p. 151) three hypotheses to explain observed variation in Indo-West Pacific species of the genus: (1) small specimens exhibiting wide variation die before reaching maturity; (2) small specimens represent dwarf races capable of "breeding and perpetuating their precise type"; (3) with growth, small specimens lose their characteristic features and assume the typical facies. Kemp suggested that the second hypothesis was improbable and that most likely variation could be explained by growth changes.

More recently, students of the group have begun to accept the possibility that species might mature at different sizes. Bigelow (1931) suggested some support for this hypothesis, and Serène (1954) recognized two dwarf races ("race naine") from Viet Nam: *G. chiragra* var. *viridis* and *G. falcatus* var. *ternatensis* de Man, 1902. In the western Atlantic, Manning (1967) reported on small species of *Gonodactylus* that had adult features at TL 20 mm and that could be distinguished with no difficulty from the larger species.

The current study shows that in addition to *G. demanii* there are six recognizable species of small size in the Indo-West Pacific, and a survey of the literature indicates that several more may have been recognized in the past by other authors. These include *G. chiragra* var. *affinis* de Man, 1902, and *G. c.* var. *confinis* de Man, 1902, both from Ternate, Indonesia, and *G. c.* var. *segregatus* Lanchester, 1903, from the Maldive and Laccadive Islands. *Gonodactylus affinis* and *G. segregatus* are, from their accounts, very similar, and *G. confinis* may prove to be conspecific with *G. incipiens*, recognized below.

One of the features characteristic of *G. demanii*, sensu stricto, and *G. hendersoni*, new species, described herein, is the absence of setae on the inner edges of the uropodal exopod and endopod; *G. demanii* may have a few proximal setae on the inner margin of the endopod, but most of the inner margin is bare and smooth. In this feature these two species resemble two other species currently placed in *Mesacturus* Miers (=*Gonodactylus* Group II of Kemp, 1913), *M. drepanophorus* (de Man, 1902) and *M. herdmani* (Tattersall, 1906). The telson morphology of these two pairs of species also seems to be similar, but the two species placed in *Mesacturus* differ in having a sharply trispinous rostral plate. Further study may show that both *M. drepanophorus* and *M. herdmani* should be reassigned to *Gonodactylus*, for neither have the strongly recurved spines on the uropodal exopod characteristic of the other species of *Mesacturus*.

Gonodactylus demani var. *pruvotae* Gravier, 1930, from New Caledonia, has been shown by Serène (1952) to be a synonym of *Mesacturus spinosocarinatus* (Fukuda, 1909). It need not be discussed further here.

This study indicates that the Indo-West Pacific species of *Gonodactylus* are not distributed necessarily throughout the area. *Gonodactylus espinosus* is apparently a Pacific species that does not occur in the Indian Ocean; *G. incipiens* may also occur only in the Pacific although it has been recorded in the Indian Ocean. *Gonodactylus hendersoni* has a wider distribution pattern, between Hawaii and Burma, but it has not been recorded from the western Indian Ocean. Four of the species discussed herein, including *G. demanii*, *G. spinosus* and two new species, are known to occur only in the western Indian Ocean and Red Sea.

Analysis of certain Indo-West Pacific species of *Gonodactylus* as well as work on the American species leads me to believe that qualitative aspects of telson morphology are very important taxonomic characters in this genus. The overall shape of the telson, the shape and position of the marginal teeth and their carinae, the shape and position of the dorsal carinae, and the presence and size of dorsal spinules or tubercles are all important specific characters. It must be kept in mind that the relative tumidity of the median and anterior submedian carinae may change with age and may differ by sex. Characters of the telson in combination with characters afforded by the ocular scales, the rostral plate, the general shape of the lateral processes of the thoracic somites, and especially in the *demanii* section, the shape and setation of uropods, provide excellent characterizations of the species now known. Color patterns and habitat may also prove to be important.

In the material examined, the number following the number of specimens and sex is total length (TL), measured along the midline from the apex of the rostral plate to the apices of the submedian spines of the telson; all measurements are in millimeters (mm). All specimens are in the U.S. National Museum. The illustrations were prepared by my wife Lilly. The support of this study through the Research Awards Program of the Smithsonian Institution is gratefully acknowledged.

In the following key I have included only the species reported herein. Too little is known of the characteristics of *G. affinis*, *G. confinis*, and *G. segregatus* to include them.

Key to *Gonodactylus demanii* and Allies

1. Inner margin of uropodal endopod largely or completely devoid of setae, margin smooth 2

Inner margin of uropodal endopod completely fringed with setae, margin serrate at insertion of setae 3

2. Rostral plate with sharp anterolateral angles; submedian teeth of telson with well-marked ventral carina; inner margin of uropodal endopod completely devoid of setae . . . . . **hendersoni,** new species, p. 4

Rostral plate with rounded anterolateral angles; submedian teeth of telson poorly or not carinate; inner margin of uropodal endopod with 1–10 proximal setae . . . . . **demanii,** p. 8

3. Telson with dorsal spinules or spines 4

Telson smooth dorsally 5

4. Telson broader than long, dorsal spinules large; lateral marginal teeth prominent . . . . . **lanchesteri,** new species, p. 11

Telson as long as broad, dorsal spinules small; lateral marginal teeth obscure . . . . . **spinosus,** p. 14

5. Proximal segment of uropodal exopod lacking fixed distal spine ventrally; lateral processes of sixth and seventh thoracic somites subequal. **choprai,** new species, p. 16

Proximal segment of uropodal exopod with fixed distal spine ventrally; lateral process of sixth thoracic somite noticeably larger than that of seventh somite 6

6. Intermediate teeth and denticles well-formed; uropodal setae in one marginal series . . . . . **incipiens,** p. 18

Intermediate teeth and denticles poorly formed, apex of teeth appressed to margin of submedians; uropodal setae in several series on margin of endopod . . . . . **espinosus,** p. 21

Gonodactylus hendersoni, new species

FIGURES 1–2

Gonodactylus new species de Man, 1888, p. 574, pl. 22a (fig. 7).

Gonodactylus demani.—Kemp, 1915, p. 182.—Roxas and Estampador, 1930, p. 121.—Roxas, 1930, p. 18.—Serène, 1953, pp. 506, 507 [listed]; 1954, pp. 6, 10, 83, figs. 13–9, 14.—Stephenson and McNeill, 1955, p. 250.

Gonodactylus chiragra var. *Demanii.*—Hansen, 1926, p. 26.

Gonodactylus demanii.—Holthuis, 1941, p. 282, fig. 8b [part].—Dollfus, 1959, p. 242 [part; discussion].

HOLOTYPE.—1♀, 22.3; Burma; G. E. Gates; USNM 120467.

PARATYPES.—2♀, 22.5–23.3; Waikiki, Oahu Id., Hawaiian Ids.; coral head; R. A. Kinzie, III; USNM 120469. 1♀, 16.5; Naha, Okinawa; *Albatross;* 1906; USNM 120468.

DESCRIPTION.—Basal portion of rostral plate angled anterolaterally, anterior margins straight, almost transverse or sloping anterolaterally.

Ocular scales obscure, low, rounded, possibly fused along midline.

Mandibular palp and 5 epipods present.

Lateral processes of sixth and seventh thoracic somites subtruncate, rounded anteriorly and posteriorly, subequal in size.

Sixth abdominal somite with 6 swollen carinae, each with small apical spine.

Telson slightly wider than long, with 3 pairs of marginal teeth, submedians slender, with movable apices; intermediates well formed, slender, apices spiniform; lateral teeth well developed, apices sharp; dorsal surface of telson with spinules or tubercles; median carina

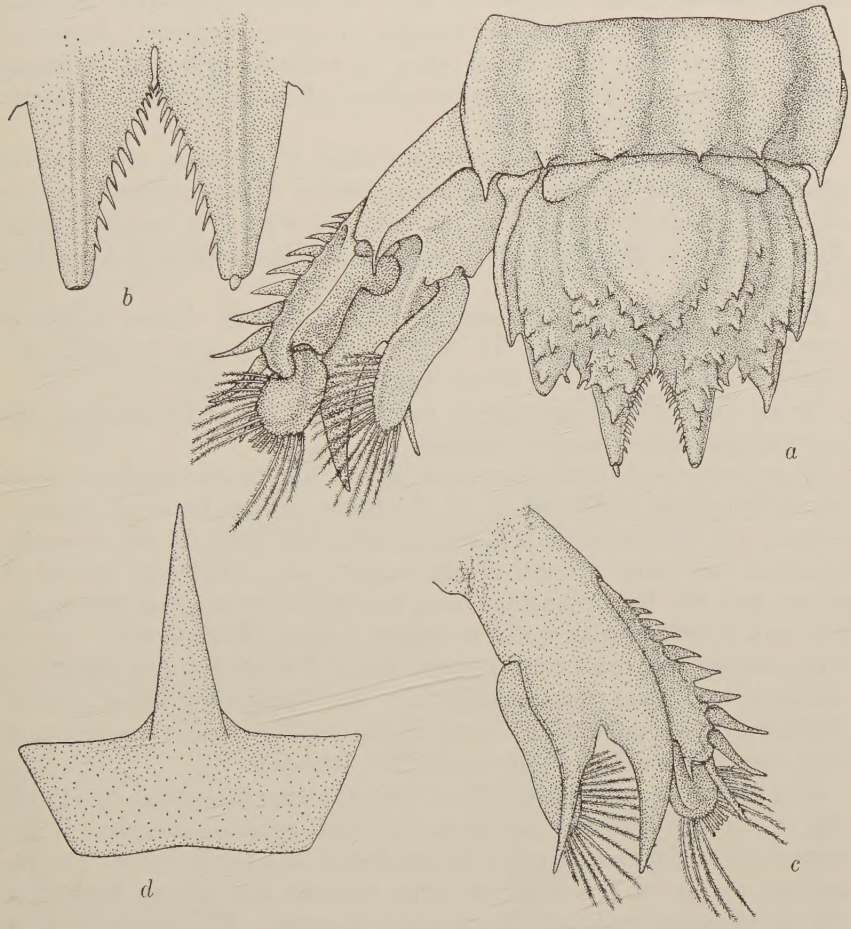

FIGURE 1.—*Gonodactylus hendersoni*, new species, female paratype, TL 23.3, Waikiki: *a*, last abdominal somite, telson, and uropod; *b*, submedian teeth of telson, ventral view; *c*, uropod, ventral view; *d*, rostral plate.

moderately or very inflated, flanked laterally by 1 or more irregular rows of spines converging posteriorly on spined knob; anterior submedian carinae short, rounded, flanked laterally and posteriorly with large, irregularly placed spines; dorsal carinae of submedian teeth with dorsal patch of large spines; numerous spaced submedian

denticles present; 2 spiniform intermediate denticles present, recessed anteriorly; submedian teeth slender, each with prominent longitudinal carina on ventral surface, carina sharp throughout its length; intermediate teeth with shorter ventral carina.

Basal segment of uropod with at most a faint prominence inside dorsal carina; inner margin of both segments of exopod smooth, nonsetose; endopod with inner margin straight, completely devoid of setae; exopod with fixed distal spine on ventral surface of proximal segment; basal prolongation with spines subequal in length, slender inner spine shorter than outer.

Color.—In preservative, posterior third of carapace and midline of sixth thoracic and first abdominal somites with rectangular patch of dark chromatophores; patch on carapace with 2 submedian black spots, those on thoracic and abdominal somites each with 1 median black spot.

Size.—Females only examined. TL 16.5–23.3. Other measurements of female holotype, TL 22.3: carapace length 4.4; fifth abdominal somite width 3.4; telson length 2.6, width 3.0.

Etymology.—The species is named for J. R. Henderson, the carcinologist who named *G. demanii.*

Discussion.—*G. hendersoni,* new species, can be distinguished from all other species in the genus by the following combination of characters: (1) the rostral plate is angled anterolaterally; (2) the uropodal endopod and inner margin of the exopod are completely devoid of setae; and (3) the submedian and intermediate teeth of the telson are each provided with a sharp ventral carina. *Gonodactylus hendersoni,* new species, most closely resembles *G. demanii* but can always be distinguished from that species by the characters listed above. Holthuis (1941) pointed out some of these differences in specimens of both species from Indo-Malaya and the Red Sea.

The female from Burma differs from the two Hawaiian specimens (fig. 1) in the following features: (1) the anterior margins of the rostral plate slope anteriorly; (2) the telson has fewer spines; (3) the median carina of the telson is more circular but not as high; and (4) the uropodal endopod is noticeably broader. The specimen from Okinawa (fig. 2), although smaller, resembles that from Burma. In other features these specimens agree closely.

Distribution.—Indo-West Pacific, from the coast of Burma eastward to Hawaii. Records in the literature: off Savu, Seva, and Ambon anchorage, Indonesia (Hansen, 1926); Pulo Edam, Indonesia (de Man, 1888); Kambang, Koepang, and Tidore, Indonesia (Holthuis, 1941); Green Id., Queensland, Australia (Stephenson and McNeill, 1955); Viet Nam (Serène, 1953, 1954); Puerto Galera, Mindoro, Philippine Ids. (Roxas and Estampador, 1930), and Taytay,

FIGURE 2.—*Gonodactylus hendersoni*, new species, female paratype, TL 16.5, Okinawa: *a*, last abdominal somite and uropod; *b*, submedian teeth of telson, ventral view; *c*, rostral plate.

Palawan Id., Philippine Ids. (Kemp, 1915; Roxas and Estampador, 1930). The habitat and depth range have not been recorded.

In compiling the synonymy of *G. hendersoni*, new species, I have assumed that all records from southern India and the western Indian Ocean should be referred to *G. demanii*.

Gonodactylus demanii Henderson, 1893

FIGURE 3

Gonodactylus Demanii Henderson, 1893, p. 455, pl. 40 (figs. 23–24).—Thurston, 1895, p. 120.

Gonodactylus spinosus.—Lenz, 1905, p. 387, pl. 47 (fig. 12).

Gonodactylus Demani.—Nobili, 1905, p. 11.—Parisi, 1940, pp. 4, 6.

Gonodactylus de Mani.—Nobili, 1906, p. 158.

Gonodactylus De Mani.—Nobili, 1906a, p. 330.—Lenz, 1910, p. 572.—Maccagno, 1936, p. 179.—Dollfus, 1938, p. 213, fig. 16.

Gonodactylus demani.—Borradaile, 1907, pp. 210 [key], 212.—Kemp, 1913, pp. 164, 198, pl. 9 (figs. 108–111).—Tattersall, 1921, p. 359.—Kemp and Chopra, 1921, pp. 297, 309.—Gravely, 1927, p. 151.—Gravier, 1935, p. 360, fig. 3?.—Ramadam, 1936, p. 8.—Taramelli, 1955, pp. 44, 47.

Gonodactylus demanii.—Holthuis, 1941, p. 282, fig. 8a [part].—Stella, 1955, p. 69.—Dollfus, 1959, p. 242 [part; discussion].

Gonodactylus demani demani.—Ingle, 1963, p. 27 [part].

MATERIAL.—1 ♂, 20.9; 1♀, 18.6; Dorom Id., Dahlak, Red Sea; A. Ben Tuvia; Sta. E57/522; Dec. 27, 1957; exchange from BMNH; USNM 120471. 1 ♂, 23.8; 1♀, 30.1; Tor and Ain Musa, Gulf of Suez; R. B. S. Sewell; exchange from BMNH; USNM 120472. 1♀, 21.5; western end of Astola Id., ca. 177 mi. west of Karachi, West Pakistan; 0–8 ft., in rocks, sand, scanty, scattered coral; Sta. LW–1; L. P. Woods, et al; IIOE; Nov. 27, 1963; USNM 120473. 1 young ♀, ca. 10.0; ½ mi. northeast of Hare Id., Gulf of Mannar, S. India; from dead coral, 1.5–3 ft.; Sta. GA–64–13a; J. S. Garth; IIOE; Feb. 22, 1964; USNM 120470.

DESCRIPTION.—Basal portion of rostral plate with anterior margins almost transverse; anterolateral angles subacute but rounded.

Ocular scales small, low, rounded or subtruncate.

Lateral processes of sixth and seventh thoracic somites rounded or subtruncate, subequal in size or that of seventh somite slightly larger.

Mandibular palp and 5 epipods present.

Sixth abdominal somite with 6 swollen carinae, each usually armed with apical spinule, spinules obsolete in larger specimens.

Telson broader than long, with 3 pairs of marginal teeth, submedians with movable apices, intermediates and laterals with sharp apices; dorsal surface of telson with spinules; submedian anterior prominences on telson often tuberculate; median carina moderately or very inflated, with 1–3 posterior tubercles; posterolateral margin of median carina

with 0–2 spinules in row converging on anchor; anchor with 1–3 spinules; anterior submedian carinae short, swollen, with apical and postapical spinules and 0–1 lateral and 0–2 dorsal spinules; carinae of submedian teeth with 1–3 dorsal spinules or tubercles; intermediate carinae with 2–3 spinules or tubercles in 1 longitudinal row or 5–6 in 2 rows; numerous small submedian denticles present; 2 sharp intermediate denticles present, recessed anteriorly, inner set on rounded lobe; ventral surface of submedian teeth of telson with low carina on inner side; intermediate teeth lacking ventral carina.

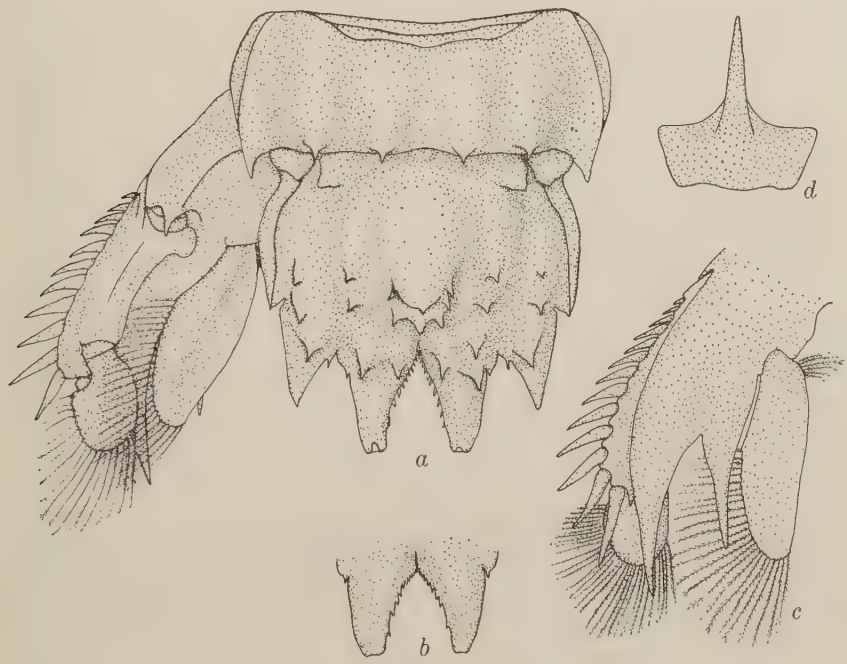

FIGURE 3.—*Gonodactylus demanii* Henderson, female, TL 18.6, Dahlak: *a*, last abdominal somite, telson, and uropod; *b*, submedian teeth of telson, ventral view; *c*, uropod, ventral view; *d*, rostral plate.

Basal segment of uropod without well-marked lobe or projection on dorsal surface inside dorsal carina; proximal segment of exopod nonsetose except for scattered small setae on proximal third; distal segment of exopod with inner margin nonsetose; proximal segment of exopod with fixed distal spine on ventral surface; endopod broad, inner margin convex proximally, concave distally, smooth except for 1–10 proximal plumose setae; apex and outer margin of endopod completely fringed with setae; inner spine of basal prolongation slender, prominent, almost as long as outer spine.

Color.—Largely faded in present material; bodies of some specimens show traces of scattered black chromatophores concentrated in dorsal patches on sixth thoracic and first abdominal somites.

Size.—Males, TL 20.9–23.8; females, TL ca. 10.0–30.1. Other measurements of male, TL 20.9: carapace length 4.3; fifth abdominal somite width 3.7; telson length 2.5, width 2.9.

Discussion.—*G. demanii* is very similar to *G. hendersoni* in general appearance but differs in having rounded anterolateral angles on the rostral plate, in having a few proximal setae on the inner margin of the uropodal endopod, and in lacking the strong ventral carinae on the submedian and intermediate marginal teeth of the telson.

In general, the carinae of the telson of males are more tumid than those of females, but dorsal tubercles of females are usually sharper.

The number and arrangement of tubercles on the telson are quite variable, but the posterior end of the median carina, the anchor, and the dorsal surface of the other carinae are always armed. The tubercles on the submedian teeth are usually arranged side-by-side, rarely forming a triangle. On the intermediate teeth the tubercles may be arranged in one or two longitudinal rows.

The very small specimen from Hare Id. in the Gulf of Manaar is tentatively assigned here. There are traces of one or two small, proximal setae on the inner margin of the uropodal endopod, the distal segment of the uropodal exopod is more rounded than in the small specimen of *G. hendersoni* from Okinawa, and the ventral carinae on the telson are very poorly developed. Further, the specimen almost completely lacks the dorsal spinules of the telson.

The illustrations of color pattern given by Gravier (1935) were based on an outline drawing of *G. chiragra* (Fabricius).

Distribution.—Western Indian Ocean, from localities between India and Moçambique. Records include: Madras Harbor, India (Kemp and Chopra, 1921); Rameswaram, Gulf of Mannar (Henderson, 1893; Thurston, 1895; Ingle, 1963); Paniban and Shingle Id., Gulf of Mannar (Gravely, 1927); Bombay, India (Kemp, 1913); Karachi, West Pakistan (Kemp, 1913); Astola Id., West Pakistan; Persian Gulf (Nobili, 1906; Kemp, 1913); Arabian Sea (Kemp, 1913); from scattered localities in the Red Sea (Nobili, 1906a; Tattersall, 1921; Kemp and Chopra, 1921; Maccagno, 1936; Ramadam, 1936; Parisi, 1940; Holthuis, 1941; Stella, 1955; Ingle, 1963); Zanzibar (Lenz, 1905, 1910; Nobili, 1905; Borradaile, 1907; Taramelli, 1955); Aldabra Id. (Lenz, 1905, 1910); Ibo Archipelago (Kemp, 1913); and from Fort Dauphin (Gravier, 1935) and Maromondia (Dollfus, 1938), Malagasy Republic.

Gonodactylus lanchesteri, new species

FIGURE 4

Gonodactylus spinosus.—Nobili, 1906a, p. 330.
Gonodactylus demani var. *spinosus*.—Tattersall, 1921, p. 361.—Ramadam, 1936, p. 9.—Chopra, 1939, p. 172.
Gonodactylus Demani var. *spinosus*.—Parisi, 1922, pp. 4, 6; 1940, p. 4.
Gonodactylus Demani spinosus.—Gruvel, 1936, p. 177.
Gonodactylus demani spinosus.—Monod, 1937, p. 19.—Ingle, 1963, p. 28, figs. 25, 55.
Gonodactylus De Mani var. *spinosus*.—Dollfus, 1938, p. 215, fig. 17.
?*Gonodactylus demanii*.—Barnard, 1950, p. 862, fig. 3e.

HOLOTYPE.—1 ♂, 34.2; Junghi Bay, Ibo Archipelago, Moçambique; sand, mud, shell; 5–18 fms.; A. Patience; USNM 120286.

PARATYPES.—1 ♂, 22.7; 5 ♀, 22.3–31.5; data as in holotype; USNM 44493.

OTHER MATERIAL.—1 ♂, 17.4; Eylath, Red Sea; Sta. E55/710; H. Steinitz; Nov. 30, 1955; exchange from BMNH; USNM 120288. 1♀, 16.8; Eylath, Red Sea; Sta. E55/735a; H. Steinitz; Nov. 30, 1955; exchange from BMNH; USNM 120287. 4 ♂, 15.6–24.8; Andromache Reef, ¼–¾ mi. offshore from Mombasa, Kenya; 0–1 m, coral reef and tide pools; Taylor, et al., Sta. RS–4; IIOE; Nov. 16, 1964; USNM 120291. 1 ♂, 29.8; 2 ♀, 24.8–25.9; Andromache Reef, south of south channel off Mombasa Id., Mombasa, Kenya; ⅓–1 m in reef lagoon; L. S. Kornicker; IIOE; Nov. 15, 1964; USNM 120293. 1 ♂, 19.4; Andromache Reef, off Mombasa, Kenya; reef flat, 0–3.5 ft.; Fehlman, et al., Sta. HA–2; IIOE; Nov. 16, 1964; USNM 120294. 1 ♂, 21.9; southwestern end of Mouniameri Id., between Mayotta and Pamanzi Ids., Comoro Ids.; rocky lava and coral reef; 0–4 m; Taylor, et al., Sta. RS–14; IIOE; Nov. 23, 1964; USNM 120292.

DESCRIPTION.—Basal portion of rostral plate rounded anterolaterally, anterior margins of basal portion transverse or sloping posterolaterally.

Ocular scales low, rounded or subtruncate.

Mandibular palp and 5 epipods present.

Lateral processes of sixth and seventh thoracic somites rounded or subtruncate, subequal in size.

Sixth abdominal somite with 6 swollen carinae, apical spines occasionally absent on larger specimens.

Telson broader than long, with 3 pairs of marginal teeth, submedians with movable apices; intermediate and lateral teeth short, blunt, apices rounded, sharper in smaller specimens; lateral teeth distinct; median carina very inflated in all specimens, in some merging laterally with anterior submedians; dorsal spinulation of telson variable, with scattered spines all over dorsal surface or with smooth

dorsal carinae, spinules or tubercles restricted to carinae of submedian and intermediate teeth; anchor not distinct, fused with median carina; carinae of submedian teeth swollen, with several scattered dorsal tubercles or spinules proximally; carinae of intermediate teeth swollen, with few scattered dorsal tubercles or spinules; numerous small, distinct submedian denticles present; 2 intermediate

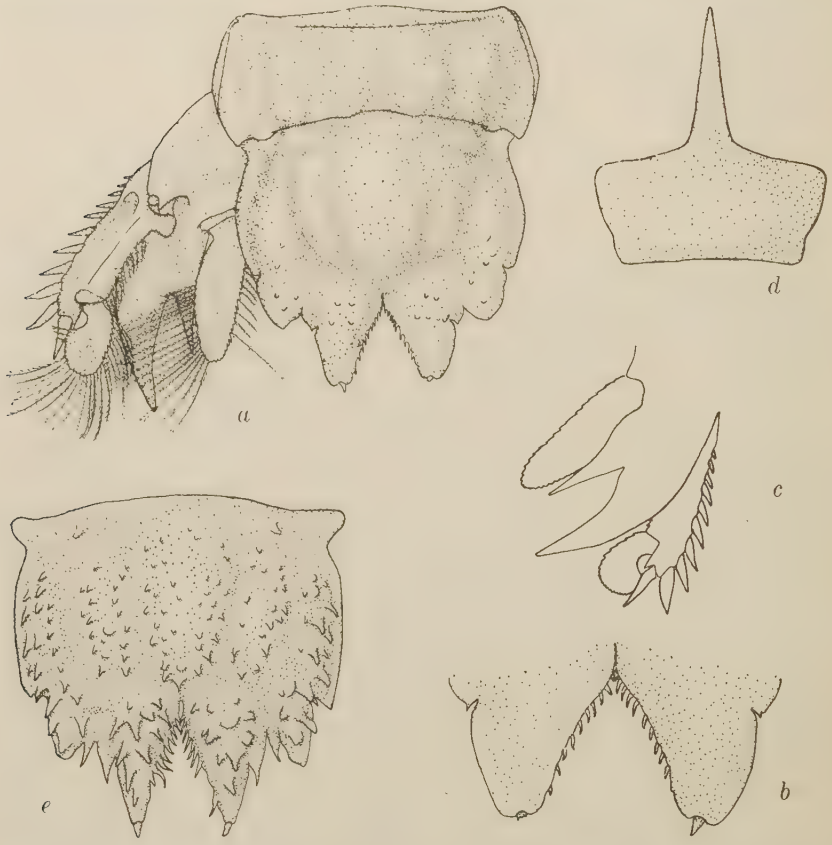

FIGURE 4.—*Gonodactylus lanchesteri*, new species, male holotype, TL 34.2, Junghi Bay: *a*, last abdominal somite, telson, and uropod; *b*, submedian teeth of telson, ventral view; *c*, ventral view of uropod (setae omitted); *d*, rostral plate. Female paratype, TL 22.3, Junghi Bay: *e*, telson.

denticles present, both usually recessed anteriorly, apex of inner occasionally reaching to or beyond apex of teeth; sharp lateral denticle present on some specimens; submedian teeth lacking well-defined ventral carina.

Basal segment of exopod with inconspicuous lobe on dorsal surface inside of dorsal carina; uropodal endopod slender, inner margin

almost straight, completely fringed with setae; both segments of exopod with normal complement of setae; proximal segment of exopod with fixed distal spine on ventral surface; basal prolongation with inner spine slender, shorter than outer.

Color.—Several specimens have dark chromatophores scattered over the body, concentrated in dark patches on the sixth thoracic and first abdominal somite, and in transverse bands on the carapace and abdominal somites; sixth thoracic somite with dark lateral patches.

Size.—Males, TL 15.6–34.2; females, TL 16.8–31.5. Other measurements of male holotype, TL 34.2: carapace length 7.7; fifth abdominal somite width 6.3; telson length 4.8, width 5.3.

Etymology.—The species is named for W. F. Lanchester, the carcinologist from Cambridge who was the first to recognize the importance of the diversity of the structure of the telson in *Gonodactylus*.

Discussion.—*G. lanchesteri* is most similar to *G. spinosus* Bigelow, differing primarily in the telson having well-developed intermediate marginal teeth, being wider than long, and having fewer (and usually larger) dorsal spinules. As in *G. hendersoni*, the number and arrangement of spinules on the telson is very variable. *G. lanchesteri* has no trace of the ventral carinae on the submedian marginal teeth of the telson that are characteristic of *G. demanii* and *G. hendersoni*, and the full complement of setae on the uropod distinguishes both *G. lanchesteri* and *G. spinosus* from *G. demanii* and *G. hendersoni*.

As in other species, the carinae of the telson and sixth abdominal somite in males are more swollen than in females, and younger specimens are more spinulose than adults. The extent of spinule variation on the telson is shown in figure 4.

There may be two species mixed in this series of specimens, both of which have well-developed intermediate marginal teeth on the telson. One of the specimens from Andromache Reef (male, TL 19.4) has many small spinules on the dorsal carinae of the telson, as does the illustrated female from the type-locality. The remainder of the specimens have far fewer spinules on the dorsal carinae of the telson and larger spinules on the carinae of the marginal teeth. I have been unable to find other differences.

Distribution.—Western Indian Ocean, from the Red Sea to South Africa. Records in the literature include Red Sea (Nobili, 1906a; Tattersall, 1921; Parisi, 1922; Gruvel, 1936; Ramadam, 1936; Monod, 1937; Dollfus, 1938; Chopra, 1939; Parisi, 1940; Ingle, 1963); Gulf of Aden (Chopra, 1939); Moçambique (Barnard, 1950); and South Africa (Barnard, 1950). On reefs from shallow water to 18 fms.

256-174—67——2

Gonodactylus spinosus Bigelow, 1893

FIGURE 5

Gonodactylus spinosus Bigelow, 1893, p. 101; 1894, p. 493.— Borradaile, 1907, pp. 210 [key], 212.—Bigelow, 1926, p. 579, figs. 1–2.—Manning, 1962, p. 3.
Gonodactylus chiragra var. *spinosus*.—Lanchester, 1903, p. 454, pl. 23 (fig. 14).
Gonodactylus demani var. *spinosus*.—Kemp, 1913, p. 165, pl. 9 (fig. 112).—Kemp and Chopra, 1921, pp. 310, 311.

MATERIAL.—1♀, 21.0; Mauritius; N. B. Pike; lectotype; USNM 64773. 1♀, 20.5; same data; paralectotype; USNM 4295. 1♂, 13.5; 1♀, 18.7; same data; USNM 120309. 1♂, 14.8; between Neptune and Triton Bastions, Galle Forte, Ceylon; from living *Pocillopora*, in 1–3 ft.; J. S. Garth, Sta. GA 64–16c; IIOE; Mar. 5, 1964; USNM 120308.

DESCRIPTION.—Basal portion of rostral plate rounded anterolaterally, anterior margins sloping posteriorly.

Ocular scales small, low.

Mandibular palp and 5 epipods present.

Lateral processes of sixth and seventh thoracic somites rounded, subequal in size.

Sixth abdominal somite with 6 well-defined carinae, submedians sharpest, all with posterior spines.

Telson as long as or longer than broad, with 3 pairs of marginal teeth; submedians thick, with movable apices, intermediates inflated, apices small but sharp, lateral barely discernible but each with small apical tubercle; most of dorsal surface of telson covered with small spinules; median carina elongate, moderately swollen, smooth dorsally, spinulose laterally and posteriorly; anterior submedian carinae elongate, moderately swollen, usually completely covered with small spinules, dorsal surface smooth in some specimens; carinae of submedian teeth swollen spinulose lobes, each as broad as tooth, completely covered with spinules; carinae of intermediate teeth swollen, spinulose dorsally and laterally, lateral spinules obscuring lateral tooth in dorsal view; numerous short submedian denticles present; 2 intermediate denticles present, inner set posterior to outer and to apex of intermediate tooth; lateral denticles present or absent; ventral surface of telson without longitudinal carinae.

Basal segment of uropod with low, rounded lobe on dorsal surface inside dorsal carina; exopod with normal complement of setae, proximal segment with fixed distal spine on ventral surface; endopod broad, margin completely setose; inner spine of basal prolongation slender, shorter than outer.

COLOR.—Faded in all specimens.

SIZE.—Male, TL 13.5–14.8; females, TL 18.7–21.0. Other measurements of female lectotype, TL 21.0: carapace length 4.6; fifth abdominal somite width 3.5; telson length 2.8, width 2.8.

Discussion.—*G. spinosus* most closely resembles *G. lanchesteri*, described above, but differs in having a narrower telson, with poorly developed intermediate marginal teeth, and in having many more, smaller dorsal tubercles on the carinae of the telson. In *G. spinosus* the intermediate denticles are set at or behind the apex of the intermediate tooth, whereas in *G. lanchesteri* they are recessed anteriorly. The basic telson shape in *G. spinosus* is similar to that found in *G.*

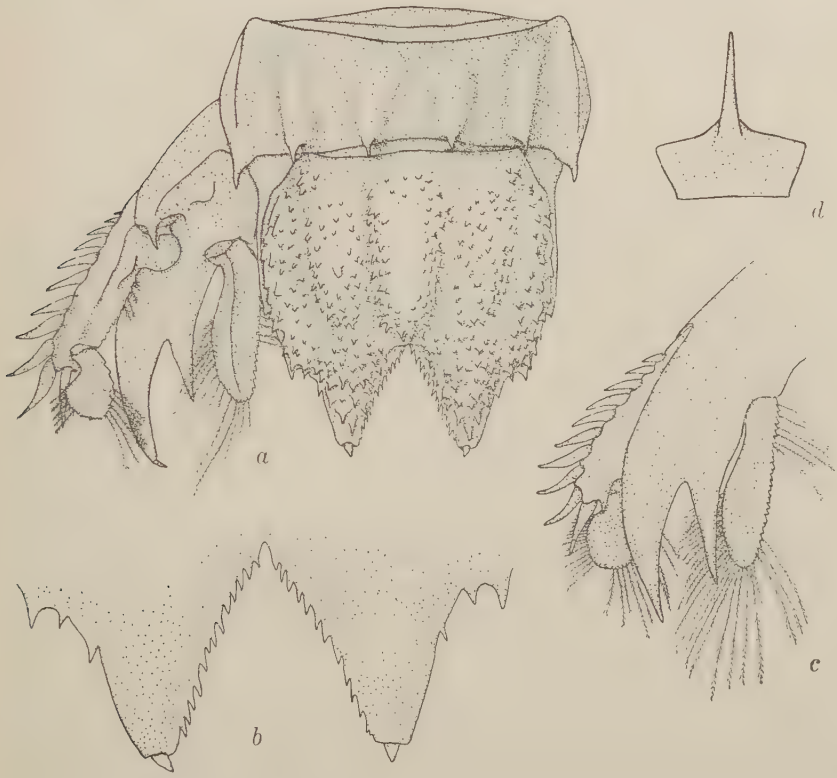

Figure 5.—*Gonodactylus spinosus* Bigelow, female lectotype, TL 21.0, Mauritius: *a*, last abdominal somite, telson, and uropod; *b*, submedian teeth of telson, ventral view; *c*, uropod, ventral view; *d*, rostral plate.

espinosus (see below), but that species differs in several features, the most important of which is the lack of dorsal spinules on the telson.

The larger of Bigelow's syntypes, a female, TL 21.0, from Mauritius, is here selected as the lectotype; the other syntype, a female, TL 20.5, from the same locality, becomes a paralectotype. Both specimens are in the U.S. National Museum.

Distribution.—Western Indian Ocean, where it has been recorded from several localities between the Persian Gulf, Mauritius, and Ceylon. Records in the literature include Pearl Banks, Persian Gulf (Kemp and Chopra, 1921); the Seychelle Ids. (Borradaile, 1907; Manning, 1962); Mauritius (Bigelow, 1893, 1894, 1926); Male Atoll and Goifurfehendu Atoll, Maldive Ids. (Lanchester, 1903); and Ceylon (Kemp, 1913). It may be restricted to shallow water.

I have assumed that records of this species from the Red Sea should be referred to *G. lanchesteri;* all material from the Red Sea examined by me proved to belong to the latter species.

Gonodactylus choprai, new species

Figure 6

Gonodactylus demani ? espinosus.—Chopra, 1939, p. 176.
Gonodactylus demani espinosus.—Ingle, 1963, p. 28, figs. 26, 56.

Holotype.—1♀, 20.4; off Somali Republic; 09°36′N, 50°01′E; *Anton Bruun* Sta. 9–444; 78–82 m; Dec. 16, 1964; USNM 120275.

Paratypes.—6♂, 11.6–16.4; 11♀, 12.2–19.3; data as in holotype; USNM 120277. 4♂, 11.3–15.0; 2♀, 14.8–20.8; off Somali Republic; 09°35′N, 50°59′E; *Anton Bruun* Sta. 9–442; 70–80 m; Dec. 16, 1964; USNM 120276.

Description.—Basal portion of rostral plate with transverse anterior margins, rounded anterolaterally.

Ocular scales small, erect, round.

Mandibular palp and 5 epipods present.

Lateral processes of sixth and seventh thoracic somites rounded, subequal, or process of sixth somite slightly larger.

Carinae of sixth abdominal somite swollen, unarmed posteriorly except for laterals.

Telson broader than long, with 3 pairs of marginal teeth, submedian well developed, with movable apices, intermediates poorly formed, laterals barely discernible, position marked by faint indentation on lateral margin; dorsal surface of telson without spinules; median carina inflated (particularly in larger males), tapering posteriorly, flanked laterally by accessory median carinae that fuse posteriorly with median; in larger specimens accessory medians separated from median by a groove or pit on each side; dorsal submedian carinae swollen, not as broad as median; carinae of submedian and intermediate teeth not markedly inflated; numerous short submedian denticles present; 2 intermediate denticles present, inner set posterior to outer; 1 or 2 small supplementary spinules on lateral margin posterior to apex of intermediate tooth; lateral denticle absent; marginal teeth without longitudinal ventral carinae.

Basal segment of uropod without well-marked lobe or projection on dorsal surface inside dorsal carina; inner margin of proximal segment and all of distal segment of exopod with single row of plumose setae on margin; proximal segment of exopod lacking fixed distal spine on ventral surface; endopod slender, tapering distally, single layer of marginal plumose setae present; inner spine of basal prolongation of uropod much smaller than outer.

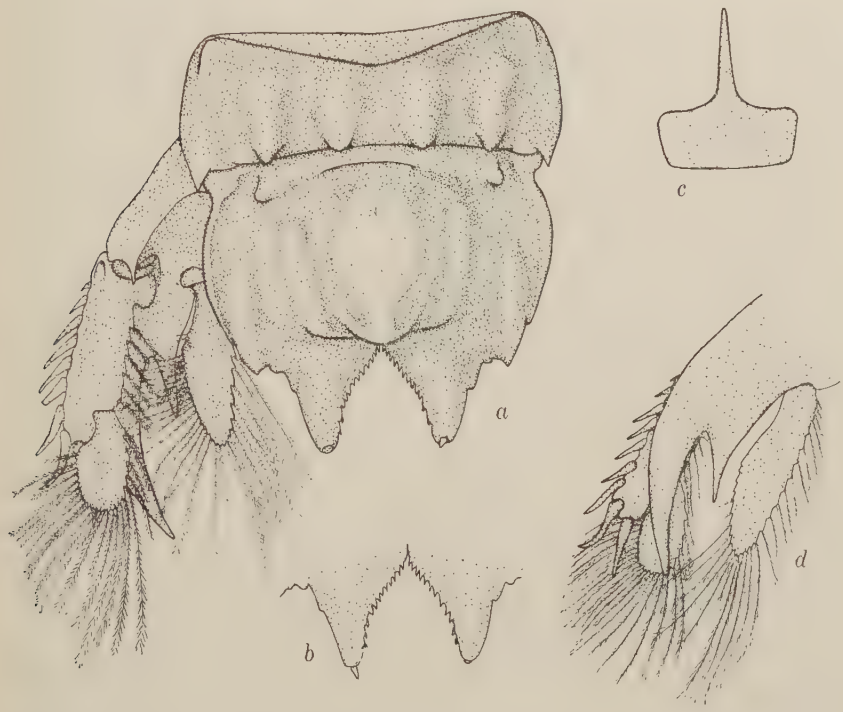

FIGURE 6.—*Gonodactylus choprai*, new species, female holotype, TL 20.4, off Somali Republic: *a*, last abdominal somite, telson, and uropod; *b*, submedian teeth of telson, ventral view; *c*, rostral plate; *d*, uropod, ventral view.

COLOR.—In preservative, body with numerous dark chromatophores scattered over light background; pleura dark, pigment most concentrated on last thoracic and last abdominal somite; posterior third of carapace, sixth thoracic segment, and first, fourth, and sixth abdominal somites with dark dorsal patch of chromatophores, that on first abdominal somite most prominent; males with dark ventral surface, pigmentation of body more intense than in females.

SIZE.—Males, TL 11.3–16.4; females, TL 12.2–20.8. Other measurements of female holotype, TL 20.4: carapace length 4.2; fifth abdominal somite width 3.6; telson length 2.5, width 3.2.

Etymology.—This species is named for Bruno Chopra, who was the first to record its occurrence.

Discussion.—*G. choprai*, new species, can be distinguished from all other species of *Gonodactylus* with small ocular scales by the absence of a fixed distal spine on the ventral surface of the proximal segment of the uropodal exopod.

In sculpture and proportion of the telson, *G. choprai*, new species, closely resembles *G. chiragra* var. *segregatus* Lanchester, 1903, from the Maldive and Laccadive Ids., and the two forms may be conspecific. Lanchester's figure shows that *G. c.* var. *segregatus* has all of the carinae of the last abdominal somite provided with posterior spines, whereas these carinae are unarmed in all of the specimens of *G. choprai* seen by me.

Lanchester's specimens apparently came from both shallow reefs and offshore habitats; there is a possibility that his material comprises more than one species.

Distribution.—Western Indian Ocean, including off the Somali Republic, the South Arabian coast (Chopra, 1939), and the Red Sea (Chopra, 1939), from moderate depths in 70–82 m. Ingle (1963) reported upon Chopra's material.

Gonodactylus incipiens Lanchester, 1903

Figure 7

Gonodactylus chiragra var. *incipiens* a Lanchester, 1903, p. 451, pl. 23 (fig. 10) [not *incipiens* b Lanchester, p. 451].
Gonodactylus chiragra var. *incipiens*.—Tattersall, 1906, p. 167.
Gonodactylus chiragra var. A *incipiens*.—Borradaile, 1907, p. 211 [key].
Not *Gonodactylus chiragra* var. *incipiens*.—Lenz, 1910, p. 571 [= *incipiens* b ??].
?? *Gonodactylus chiragra incipiens*.—Lenz, 1912, p. 4.
Gonodactylus chiragra.—Manning, 1966, p. 113 [part; *G. c.* var. *incipiens* in discussion on p. 114].

Material.—2♂, 13.4–15.3; 4♀, 15.7–20.0; Ritidian Pt., Guam Id., Marianna Ids.; R. H. Baker; July 12, 1945; USNM 120285. 1♂, 18.8; channel, Hull Id., Phoenix Ids.; killed with TNT; July 7–17, 1939; L. P. Schultz; USNM 120284. 1♀, 13.0; Fakarava Id., Tuamotu Archipelago; Oct. 13, 1899; *Albatross*; USNM 120283. 2♂, 16.6–18.6; 2♀, 21.8–24.2; coral reef at Yirrkala, Arnhem Land, Northern Territory, Australia; Australian Museum-U.S. National Museum Arnhem Land Expedition, Sta. C13–17; Aug. 26, 1948; R. R. Miller; USNM 111367.

Description.—Basal portion of rostral plate with anterior margin sloping posteriorly, rounded anterolaterally.

Ocular scales small, rounded.

Mandibular palp and 5 epipods present.

Lateral processes of sixth and seventh thoracic somites rounded anteriorly and posteriorly; process noticeably larger on sixth somite.

Carinae of sixth abdominal somite swollen, with or without posterior spines.

Telson with length and width subequal, appearing elongate, with 3 pairs of marginal teeth, submedians with movable apices; intermediate teeth well developed, apices angled but not sharp; lateral teeth obscure, apices not projecting much past lateral margin of telson; telson without dorsal spinules or tubercles; median carina very inflated and rounded in males, almost fusing laterally with dorsal submedians, more oval in females, rarely with posterior tubercle; knob not distinct, fused to median carina; carinae of marginal teeth inflated; numerous submedian denticles present; 2 sharp intermediate denticles present, recessed slightly, not projecting posteriorly past apex of intermediate tooth; submedian teeth relatively slender, ventral surface lacking longitudinal carina.

Basal segment of uropod lacking prominent lobe or projection on dorsal surface inside dorsal carina; inner margin of proximal segment and all of distal segment of exopod with single row of setae; proximal segment of exopod with small, fixed spine on distal end of ventral surface; endopod short, broad, completely fringed with setae set in 1 row; inner spine of basal prolongation slender, shorter than outer.

Color.—Faded in most of the specimens reported herein. Some of the specimens from Guam show traces of a dark median patch on the sixth thoracic and first and fourth abdominal somites.

Size.—Males, TL 13.4–18.8; females, TL 13.0–24.2. Other measurements of male, TL 18.6: carapace length 3.9; fifth abdominal somite width 2.9; telson length 2.5, width 2.6.

Discussion.—It is with some hesitation that I assign these small but obviously mature specimens to Lanchester's species without comparison with his type. The specimens agree well with the illustration of the telson provided by Lanchester, the only major difference being that in males the accessory median carinae may be completely obliterated by the tumid median carina.

In smaller specimens of either sex the accessory median carinae can be distinguished as swollen lobes separated from the posterior end of the median carina by a shallow lateral depression. In only one of the specimens the median carina of the telson is provided with a median, posterior tubercle.

Gonodactylus confinis de Man, 1902, from Ternate, Indonesia, appears to be similar in general telson structure, but, according to de Man's account, that species has a median and two submedian spinules on the end of the swollen median carina. If de Man's

species proves to be conspecific with *G. incipiens,* the older name *G. confinis* will have to be used for the species.

Gonodactylus incipiens resembles *G. choprai* in lacking dorsal spinules on the carinae of the telson, but the former differs in having a small, fixed distal spine on the ventral surface of the proximal segment of the uropodal exopod.

Both *G. incipiens* and *G. espinosus* differ from all other species reported herein in having the lateral process of the sixth thoracic

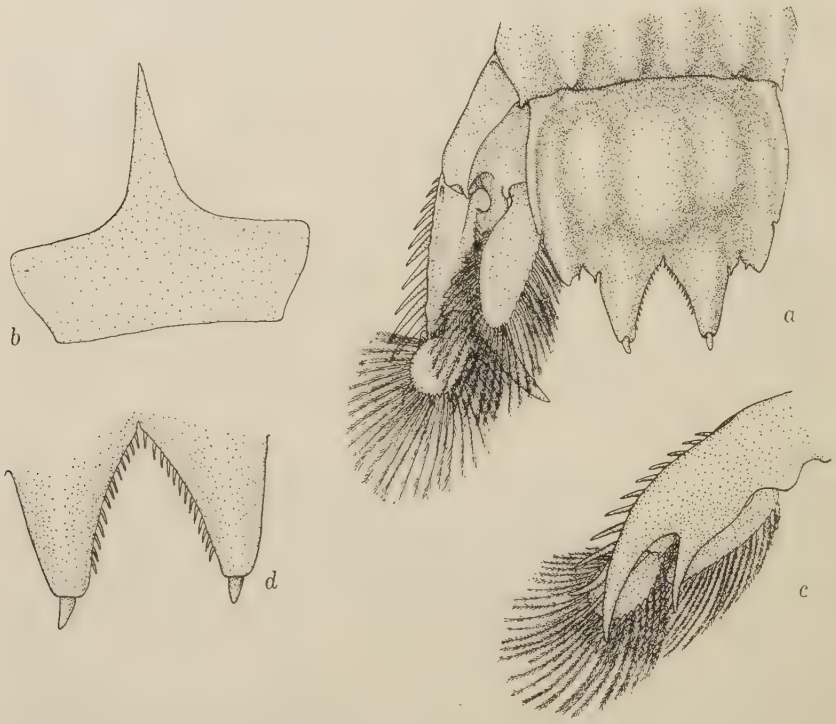

FIGURE 7.—*Gonodactylus incipiens* Lanchester, male, TL 18.8, Hull Island: *a*, last abdominal somite, telson, and uropod; *b*, rostral plate; *c*, uropod, ventral view; *d*, submedian teeth of telson, ventral view.

somite noticeably broader and more truncate than that of the seventh somite; in all the other species the lateral processes are subequal in size.

Lanchester (1903) recognized two forms in his *G. c.* var. *incipiens*: *G. c.* var. *incipiens* a was based on a small female, TL 16.5, from Funafuti, Ellice Ids., and is the form recognized herein as a distinct species; *G. c.* var. *incipiens* b was based on de Man's (1898) figure of a specimen of *G. chiragra,* presumable *G. chiragra,* sensu stricto.

J. G. de Man's specimens, TL 77–98 mm, were from the Celebes. Kemp (1913) considered *G. incipiens* to be identical with *G. chiragra*, but he made no distinction between the lettered forms and their size differences. In order to settle the identity of *G. incipiens*, the female, TL 16.5, reported by Lanchester (1903) from Funafuti, Ellice Ids., is here selected as the lectotype.

The specimens reported by Lenz (1910, 1912) probably belong to *G. chiragra* rather than to the species reported here; all are large specimens.

Manning (1966) noted that four small specimens assigned to *G. chiragra* resembled the varietal form described by Lanchester. Comparison of those four specimens from Australia with the others reported herein leaves no doubt that they are conspecific. Manning also noted that the rostral plate of the Australian specimens resembled that illustrated by Serène (1954) for *G. chiragra* var. *viridis*.

Distribution.—Indo-West Pacific, with most records from the Pacific Ocean, including Guam; Funafuti Id., Ellice Ids. (Lanchester, 1903); Hull Id., Phoenix Ids., Fakarava Id., Tuamotu Archipelago; and Yirrkala, Northern Australia (Manning, 1966). Tattersall (1906) reported a small specimen from Ceylon; his record is the only one from the Indian Ocean. Habitat and depth range are unrecorded, except for the Australian specimens, which were collected on coral reefs.

Gonodactylus espinosus Borradaile, 1898

Figure 8

Gonodactylus espinosus Borradaile, 1898, p. 35, figs. 5a–b, pl. 5; 1907, p. 210 [key].
Gonodactylus chiragra espinosus.—Lanchester, 1903, p. 455.
Gonodactylus demani espinosus.—Kemp, 1913, p. 166.
Gonodactylus chiragra.—Edmondson, 1923, p. 36, fig. 3h [not *G. chiragra* (Fabricius, 1781)].
Not *Gonodactylus demani espinosus*.—Chopra, 1939, p. 176.—Ingle, 1963, p. 28, figs. 26, 56 [=*G. choprai*, new species].

Material.—1♀, 22.7; washed from lagoon reef corals, Fanning Island, Line Ids.; 03°50′ N, 159°20′ W; Fanning Id. Expedition Sta. 6; June 30, 1963; S. Wainwright, W. Newman; USNM 120279. 2♀, 23.3–45.5; lagoon, Canton Island, Phoenix Ids.; Sta. U–39–33; Apr. 25, 1939; L. P. Schultz; USNM 120278. 1♀, 29.5; Fakarava Id., Tuamotu Archipelago; shore in lagoon; *Albatross*; Oct. 11, 1899; USNM 120282. 2♀, 11.3–21.5; same; reef; *Albatross*; Oct. 13, 1899 USNM 120281. 1♂, 13.2; Bora Bora, Society Ids.; Smithsonian-Bredin Expedition, 1957; USNM 120280.

Description.—Basal portion of rostral plate broadly rounded anterolaterally.

Ocular scales small, rounded, separate.

Mandibular palp and 5 epipods present.

Lateral process of sixth thoracic somite truncate, broader than that of seventh somite.

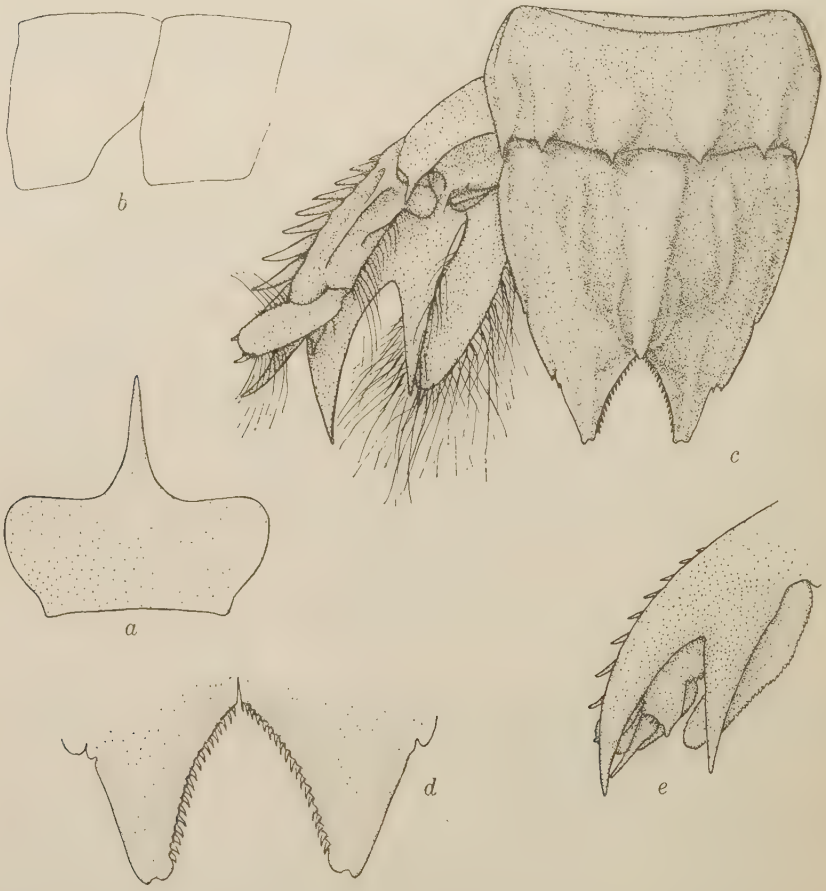

FIGURE 8.—*Gonodactylus espinosus* Borradaile, female, TL 45.5, Canton Island: *a*, rostral plate; *b*, lateral processes of sixth and seventh thoracic somites, lateral view (right side); *c*, last abdominal somite, telson, and uropod; *d*, submedian teeth of telson, ventral view; *e*, uropod, ventral view (setae omitted).

Sixth abdominal somite with 6 swollen carinae, each with small apical spine.

Telson length and width subequal, appearing elongate; 3 pairs of marginal teeth present, only submedians well developed, with movable apices; intermediate and lateral teeth poorly defined but present; dorsal surface of telson without spinules; median carina

elongate, tapering posteriorly, unarmed; accessory median carinae present on distal half or third of median, converging posteriorly with median to form an anchor; submedian carinae interrupted; carinae of intermediate and marginal teeth long, low; numerous small submedian denticles present; 1 small intermediate denticle present, situated at or posterior to apex of intermediate tooth; ventral surface of submedian teeth lacking longitudinal carina.

Basal segment of uropod lacking lobe or projection inside of dorsal carina; inner margin of proximal segment and all of distal segment of uropodal exopod with single row of setae; proximal segment of exopod with distal fixed spine under articulation of distal segment; endopod slender, tapered, margin with more than 1 row of slender setae, dorsal setae erect, especially on outer margin; basal prolongation of uropod produced into 2 spines, outer longer.

Color.—All specimens faded in preservative; Borradaile noted that his specimen was light green.

Size.—Only male examined, TL 13.2; females, TL 11.3–45.5. Borradaile's specimen, a male measured 18 mm. Other measurements of a female, TL 45.5: carapace length 9.7; fifth abdominal somite width 6.3; telson length 5.7, width 5.7.

Discussion.—*G. espinosus* can be distinguished by the shape of its telson, with poorly defined intermediate and lateral marginal teeth, by the presence of several rows of setae on the outer margin of the uropodal endopod with some setae erect, and by the broad lateral process of the sixth thoracic somite. *Gonodactylus espinosus* shares this latter feature with *G. incipiens*.

The setation of the uropod may be reduced in small specimens, but the characteristic erect setae are always present.

It might be assumed from Borradaile's figure that the carinae of the telson in males are much more tumid than those of females; the telson of a female is figured here.

Distribution.—Central Pacific Ocean, from Palmyra Id. (Edmondson, 1923) and Fanning Id., Line Ids.; Canton Island, Phoenix Ids.; Fakarava Id., Tuamotu Archipelago; Bora Bora, Society Ids.; and Rotuma, Fiji Ids. In shallow water, among reef corals in lagoons.

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